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(71) Applicant: **Iveco S.p.A.**
10156 Torino (IT)

(72) Inventor: **Lorenzetti, Giorgio**
10141 Torino (IT)

(74) Representative: **Borsano, Corrado et al**
Notarbartolo & Gervasi S.p.A.
Corso di Porta Vittoria, 9
20122 Milano (IT)

(54) **Front suspension system for an industrial vehicle with full air braking system**

(57) Front suspension system for an industrial vehicle with full air braking system, namely with rotochambers (71) integral with the calipers, comprising a leaf spring (3) constrained to the frame (22), a control arm (4) placed over said leaf spring and hinged to the frame (22) by a first end (41) and restrained to the middle of the leaf spring (3) by a second end (42). Said second end comprises a bend towards the frame, on which a limit stop pad (43) is placed. The pneumatic element (9) is placed between the frame (22) and the leaf spring (3) in correspondence of the connection of the leaf spring with the axle (6) of the wheels.

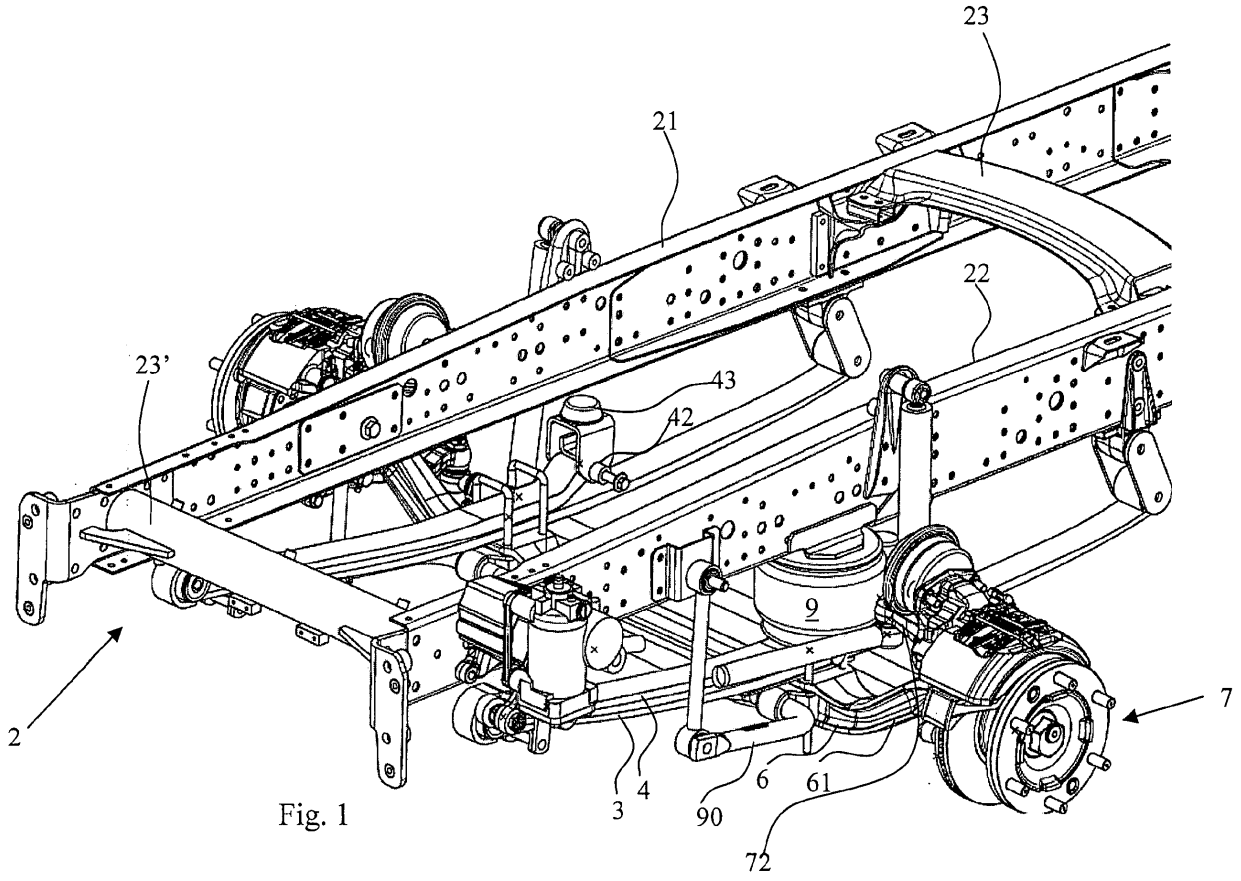

Fig. 1

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Description

Field of the invention

[0001] The present invention refers to a front suspension system for an industrial vehicle with a full air braking system, in particular for the transport of goods and/or passengers.

Description of the prior art

[0002] Pneumatic suspensions are currently used in goods vehicles, thanks to the possibility to adjust the height of the vehicle, in order to align it with the floor of any warehouse.

[0003] According to a further aspect, some goods suffer from the vibrations due to the ravelled road surface, such as fizzy drinks and explosives.

[0004] Moreover, pneumatic suspensions are particularly comfortable when carrying passengers.

[0005] On the other hand, vehicles with a narrow track are to be preferred for the final distribution of the goods, or for carrying a limited number of passengers, in order to travel more easily on the downtown roads. This category of vehicles has between 200 and 230 cm of width and from 60 quintals of carrying capacity.

[0006] Narrow track vehicles, due to part arrangement problems, are usually provided with a hydraulic or partially pneumatic braking system. Therefore, in the production line, it is necessary to contrive a working station where the drainage of the hydraulic circuit or of the portion of the hydraulic circuit is performed.

[0007] Moreover, using pneumatic suspensions is not easy, due to their considerable dimensions. The problem is even more critical when the braking system has to be of the full air type, namely comprising rotochambers. A rotochamber is a device suitable to make the caliper directly controlled by the air pressure of the pneumatic circuit. A rotochamber is assembled as integral with a caliper and extends toward the longitudinal axle of the vehicle, further limiting the space available for the suspensions.

[0008] The use of pneumatic suspensions and of full air braking system is already known in the art, but in vehicles with considerable dimensions, namely not in narrow track vehicles. The arrangement of the elements defining the suspension system and of the elements defining the braking system is particularly critical for the front axle, where steering wheels are present, since when wheels are steering, they cover an area around the hub, which has to be kept free in order to avoid limiting the steering angle.

[0009] A further problem derives from the dimensions of the engine, which has to be housed between the side members defining the vehicle frame. Therefore there should be enough space between the two side members.

[0010] One of the needs that are particularly felt for the production of said industrial vehicles is from the one hand the need to assemble a single chassis with a single suspension type suitable for any use, and from the other hand is to use the same production line for assembling vehicles with different carrying capacity. Hence a drainage station should not be arranged, when not all vehicles need it.

[0011] Therefore the technical problem to be solved is that of realizing a suspension configuration, whose dimensions allow to use a pneumatic suspension system and a full air braking system.

Summary of the invention

[0012] The aim of the present invention is to provide a front suspension system for an industrial vehicle with a full air braking system that solves all the problems set forth above.

[0013] The subject of the present invention is to provide a front suspension system for an industrial vehicle with a full air braking system, according to claim 1.

[0014] Therefore, according to the present invention, the suspension system comprises both a leaf spring and a pneumatic element.

[0015] According to a preferred alternative embodiment of the invention it comprises also a shock absorber placed beside said pneumatic element. In particular, in order to avoid interfering with the steering of the wheels, the pneumatic elements are preferably placed between the vehicle frame and the leaf springs, in correspondence of the connection of the leaf springs with the wheel axle.

[0016] Moreover, according to a preferred alternative embodiment of the invention, the rotochambers of the calipers are placed over the wheel hubs, so that articulated joints connecting to the steering gear tie rod can be placed below the hub, so that said tie rod do not interfere with the rotochambers.

[0017] The dependent claims describe the preferred embodiments of the invention, and are an integral part of this description.

Brief description of the Figures

[0018] Further characteristics and advantages of the invention will be more apparent in light of a detailed description of a preferred, but non-exclusive, embodiment of a front suspension system for an industrial vehicle with full air braking system, shown with the help of the drawings that are attached hereto, which are merely illustrative and not limitative, in which:

Fig. 1 shows a isometric view of a suspension according to the present invention,
Fig. 2 shows a side view of the suspension in figure 1,
Fig. 3 shows a view in a plan of the suspension of the previous figure,
Fig. 4 shows an enlarged view of a portion of figure 1.

[0019] In the drawings the same reference numbers

and letters are used to identify the same elements or components.

Detailed description of a preferred embodiment of the invention

[0020] With reference to figures 1 and 2, the suspension that is subject of the present invention is contrived to equip a narrow track industrial vehicle, namely with an overall width of the vehicle preferably lower than 250 cm.

[0021] The vehicle comprises a vehicle frame which consists of a pair of side members 21 and 22 parallel between each other, interconnected by cross members 23 and 23'.

[0022] The suspension subject of the invention comprises a leaf spring 3 whose first end 31 and whose second end 32 are constrained to the vehicle frame. In particular, the first end is hinged to the frame, while the second end is hinged to an arm 33, the arm being hinged to the frame. Therefore, when a stress tends to rectify the leaf spring, the arm 33 allows an axial movement of the leaf spring 3.

[0023] A control arm 4 is placed over said leaf spring, that is beside its side that faces the longitudinal member 22 of the vehicle. A first end 41 of the control arm is constrained to the frame together with said first end 31 of the leaf spring 3, that is having the same hinging point, while a second end 42, that can be seen in figure 1, is constrained to the middle of the leaf spring 3.

[0024] Said control arm is suitable to cooperate with the leaf spring in the deflexion, being at least partially adherent with the leaf spring.

[0025] The second end 42 of the control arm comprises a bend toward the frame, so that on the extremity a U bolt can be inserted, having on its upper part a pad 43 which has the function to deaden the blows of the end 42 of the control arm 4 to the frame, in particular when the stresses bring the suspension to the limit stop. This bend is a little beyond the middle of the leaf spring, as it can be seen in figure 2. The position of said pad is particularly advantageous, since it is easily reachable when it needs to be replaced, and it is visible, hence it is easy to determine its wear state.

[0026] The front axle 6 is connected to the lower part of the leaf spring 3, in correspondence of said middle area. It is U-shaped, so that the arms 61 bring the hub axis 7 above the control arm 4, as it can be seen in figure 2. This is particularly advantageous because it allows to keep the height of the suspension low and therefore also the loading platform of the vehicle is kept low.

[0027] In correspondence of the interconnection between the axle 3 and the leaf spring 3, a pneumatic element 9 is placed between the leaf spring and the side member 22.

[0028] Thus it works between the axle 6 of the wheels and the side member 22 undergoing compression stresses only, said two elements being particularly stiff.

[0029] A shock absorber 10 of any of the type known is placed beside said pneumatic element 9. A first end of said shock absorber is hinged to said second end 42 of the control arm 4, while a second end is constrained to the frame.

[0030] In particular, in order to allow the use of a shock absorber having an appropriate extension, but keeping the height of the suspension low, a plate 221 is applied to the side member 22, to which said second end 12 of the shock absorber 10 is hinged. The plate projects over the side member 22, externally with respect to the frame, that is on the side of the frame facing the hub 7 of the wheel.

[0031] Thus, as it can be seen in figures 2 and 3, the shock absorber 10 works externally with respect to the pneumatic element 9 and it does not determine an increase of the height of the suspension.

[0032] Moreover, said shock absorber 10 is placed beside the pneumatic element 9 at the minimum distance necessary for guaranteeing that the two elements do not interfere with each other, in particular during the compression of the pneumatic element 9. In particular, the shock absorber 10, in the side view of figure 2, overlaps said second end 42 of the control arm 4. Being the section of the shock absorber remarkably smaller than the pneumatic element, it does not extends towards the wheel more than the pneumatic element 9.

[0033] Moreover, the fact that the suspension 1 comprises both a pneumatic element 9, and a leaf spring 3 which cooperates with the control arm, allows the pneumatic element 9 to have small dimensions, and guarantees a low resonance frequency of the suspension.

[0034] Thanks to the disposition of the elements as described above and shown in the figures, the rotochamber 71, integral with the relative caliper, and the relative pneumatic pipe do not interfere with the suspension system, even when an excessive wear of the pads makes the caliper move toward the inside of the vehicle, namely toward the pneumatic element 9. Thus, an industrial vehicle according to the present invention, for example being 220 cm wide, can guarantee a steering angle for example of 52° and 36° or wheel angle, respectively the external angle and the interior angle that the wheel can reach with respect to a longitudinal alignment.

[0035] According to another aspect of the invention, with reference to figures 2 and 3, the caliper is placed above the hub 7, therefore the rotochamber is oriented in the twelve o'clock position with respect to the brake disc. Just under the rotochamber 71, a connection element 72 projects from the hub 7 towards the longitudinal axle of the vehicle. In such connection element an articulated joint 51 is made for connecting to the steering gear tie rod 50. Thus the articulated joint 51 is in a lower position with respect to the rotochamber 71, without interfering with it. The figure also shows the actuator 52 of the assisted driving.

[0036] According to a further aspect of the invention, with reference to figure 4 which shows an enlarged view of a portion of figure 1, a higher stability is given to the

vehicle by means of a U-shaped torsion bar 90, having a linear part parallel with the axle 6 rotatably constrained to said axle by means of one or more eyes 65.

[0037] Said torsion bar 90, comprises, for each of its ends, an arm whose free end is hinged to the vehicle frame by means of a connecting rod 95, in order to define a coupling connecting rod-crank.

[0038] Taking as reference the axle of the pneumatic element 9, the torsion bar 90 is constrained to the axle 6 on the opposite side with respect to the side where the shock absorber 10 is housed. Therefore the elements forming the torsion bar do not interfere with the shock absorber, being restrained in a space that does not interfere even with the rotation of the wheel of the vehicle during the hub movement 7.

[0039] The elements and the characteristics described in the different preferred embodiments may be combined without departing from the scope of the present invention.

[0040] From the description set forth above it will be possible for the person skilled in the art to embody the invention with no need of describing further construction details.

Claims

1. Front suspension system for an industrial vehicle with full air braking system, comprising calipers equipped with a rotochamber (71), comprising: a leaf spring (3) hinged by a first (31) and a second end (32) to the frame (22) of said vehicle, said leaf spring (3) being connected below an axle (6); a control arm (4) whose first end (41) is hinged to the frame (22) of said vehicle and whose second end (42) is restricted above said connection of the leaf spring (3) with the axle (6); a pneumatic element (9) placed between said control arm (4) and said frame (22) above said connection of the leaf spring (3) with the axle (6).

2. System according to the claim 1, further comprising a shock absorber (10) hinged between said second end (42) of said control arm (4) and the frame (22), externally to the frame by means of a plate (221) which projects over it.

3. System according to any of the previous claims, wherein said second end (42) of said control arm (4) comprises a bend towards the frame to which a U bolt is connected having a limit stop pad (43) over it.

4. System according to any of the previous claims, wherein said axle is U-shaped, and each one of its arms (61) has a hub (7) over the control arm (4).

5. System according to any of the previous claims, wherein each hub comprises a caliper equipped with a rotochamber (72) placed over the hub (7), so that the rotochamber is oriented in the twelve o'clock position.

6. System according to claim 5, wherein under the rotochamber (71), from the hub (7) towards the longitudinal axle of the vehicle a connection element (72) projects, wherein an articulated joint (51) is made for the connection to the steering gear tie rod (50).

7. System according to any of the previous claims, further comprising a torsion bar (90) which comprises for each end an arm (91) whose free end is hinged to the vehicle frame by means of a connecting rod (95), in order to define a connecting rod-crank coupling, being a linear part of said torsion bar parallel with the axle (6) and rotatably constrained to said axle by means of two or more eyes (65).

8. System according to claim 7, wherein said torsion bar (90) is constrained to the axle (6) on the opposite side with respect to the side where the shock absorber (10) is housed.

9. Vehicle comprising a front suspension system according to any of the previous claims.

10. Vehicle according to claim 9, having overall width lower than 250 cm.

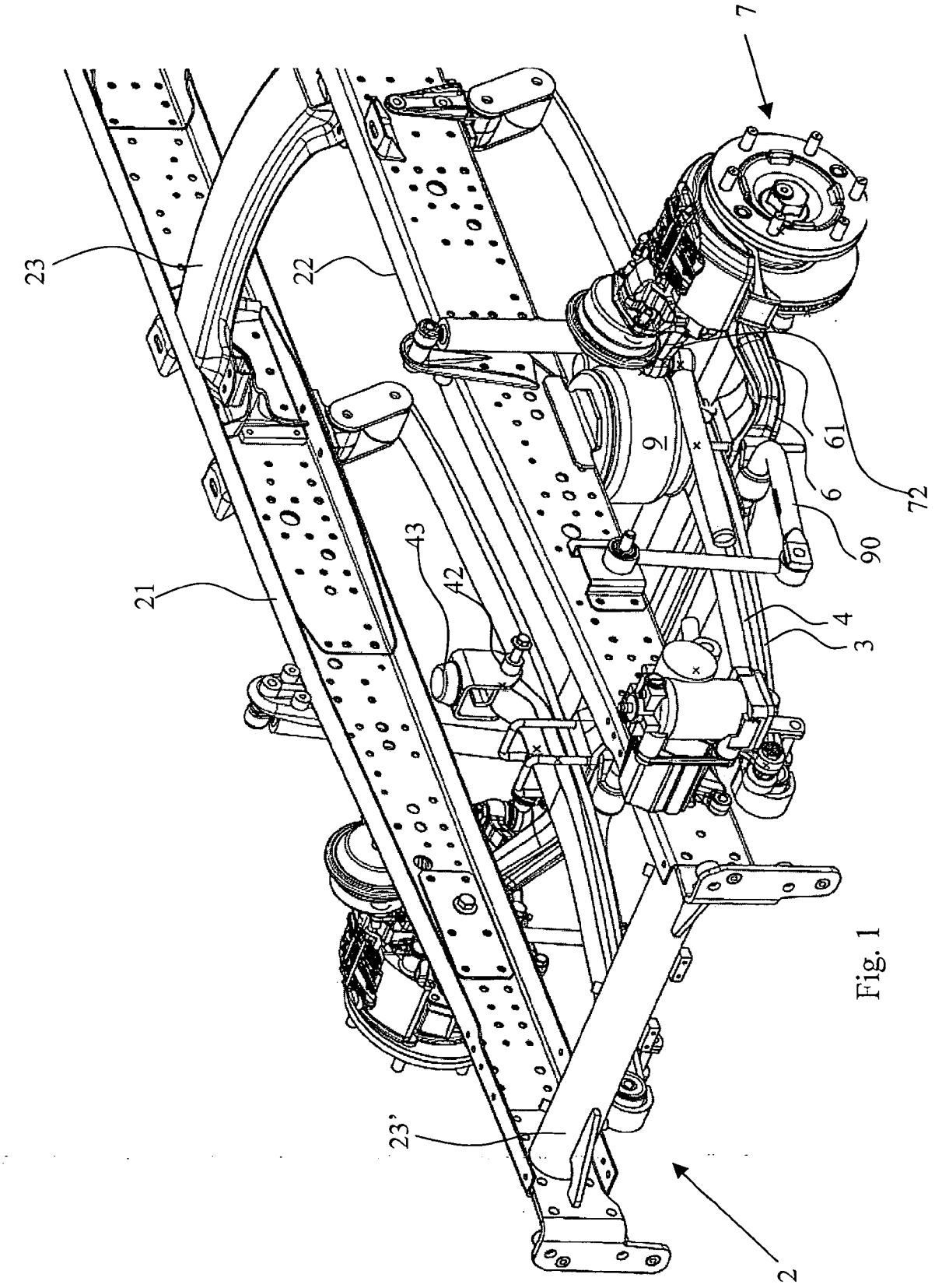

Fig. 1

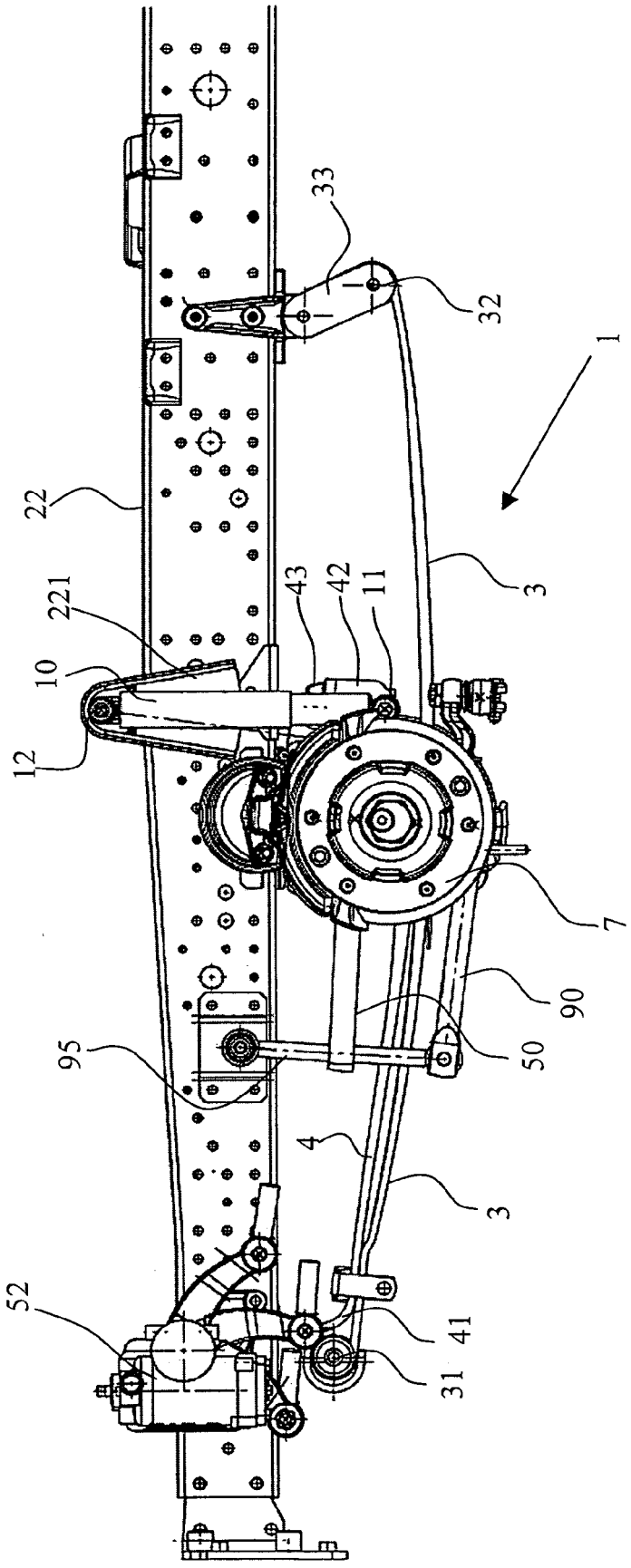

Fig. 2

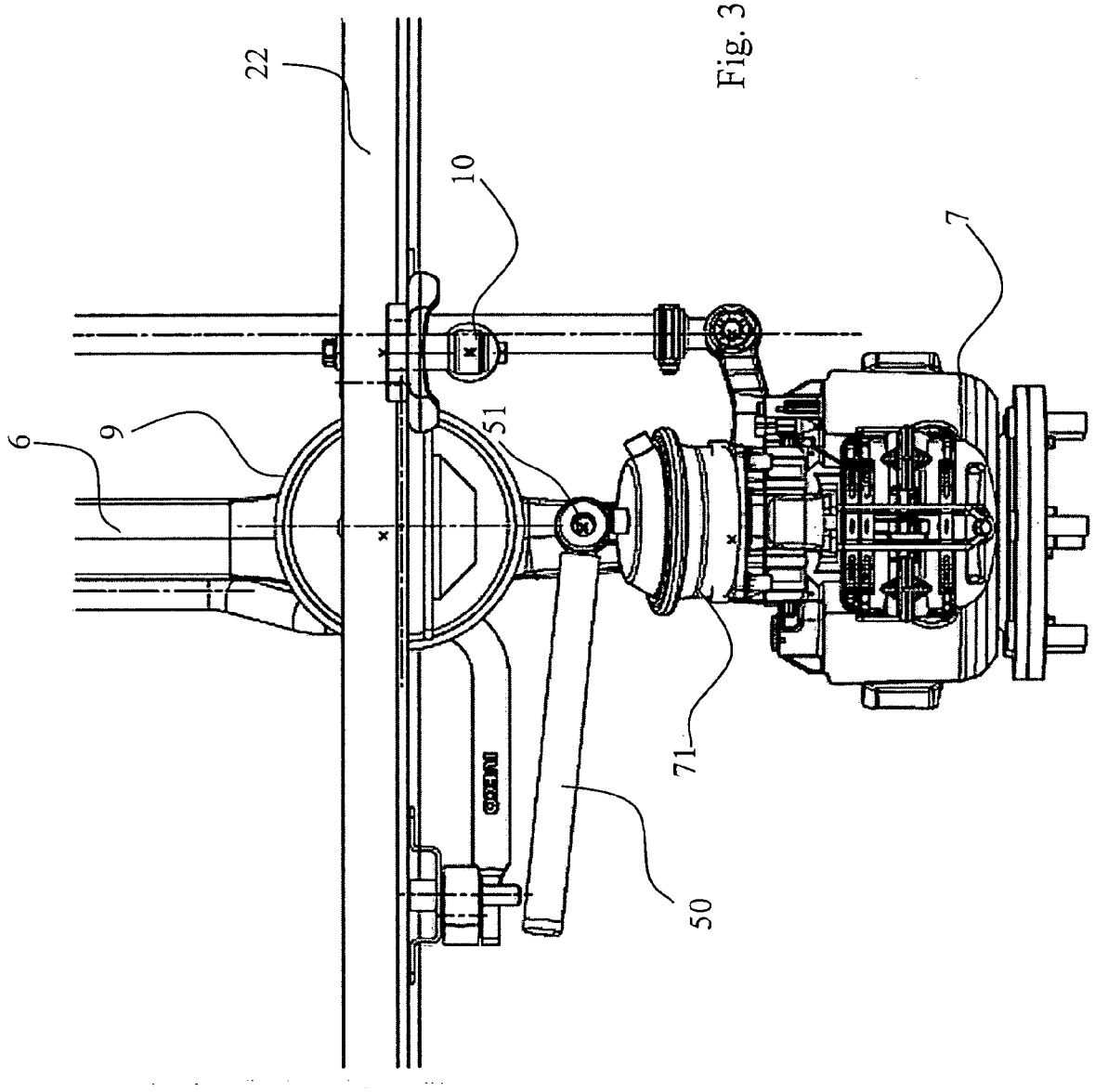

Fig. 3

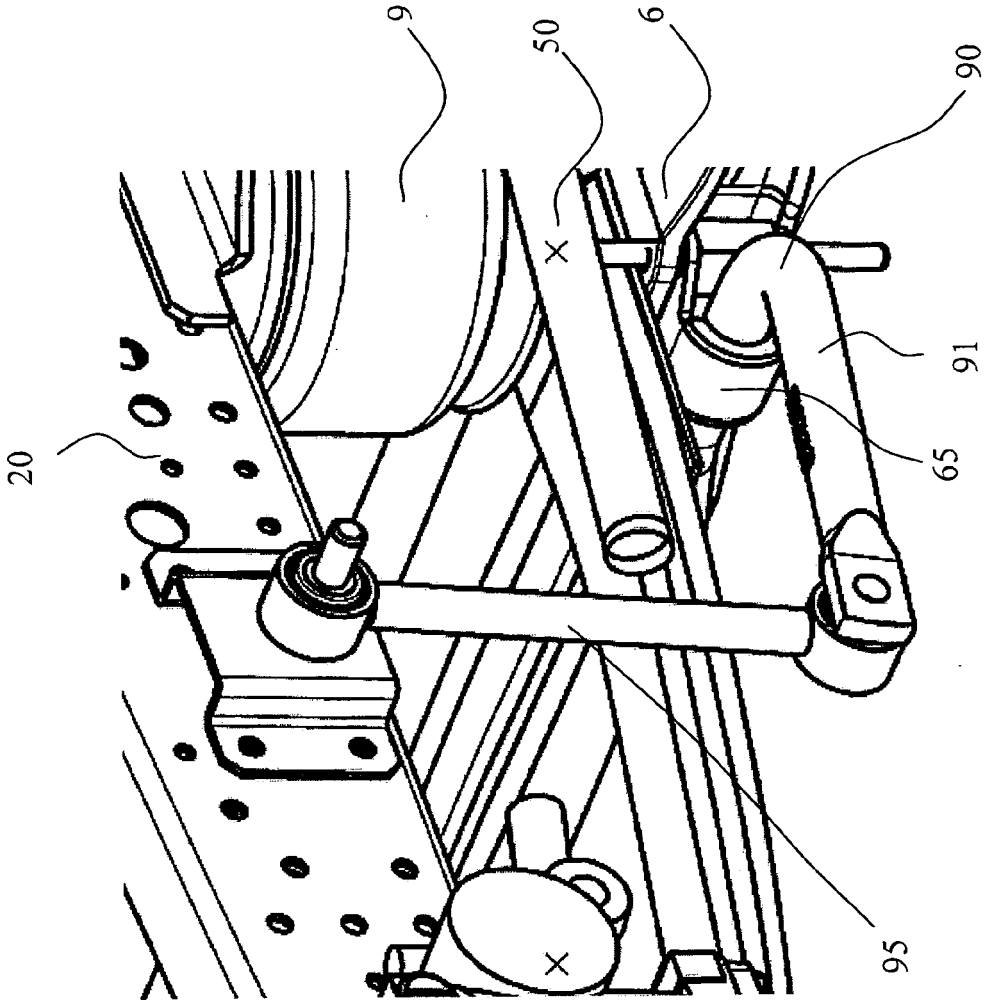

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 09 42 5447

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 April 2010	Singer, Gerhard

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